

# AMERICAN MUSEUM *Novitates*

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY  
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, N.Y. 10024  
Number 2723, pp. 1-14, figs. 1-10 February 26, 1982

## A New Montane Microhylid Frog from Papua New Guinea, and Comments on the Status of the Genus *Aphantophryne*

RICHARD G. ZWEIFEL<sup>1</sup> AND ALLEN ALLISON<sup>2</sup>

### ABSTRACT

Discovery of an undescribed, ground-dwelling species of the largely scansorial genus *Cophixalus* led to the re-evaluation of the monotypic genus *Aphantophryne* to see if this genus, presently synonymized within *Cophixalus*, should be revived to accommodate its terrestrial type species, *C. pansus*, and the new form. The two species share some presumably derived features, but

these are ones common to many microhylid species of similar ground-dwelling habits and do not necessarily indicate closeness of relationship. Evaluation of previously unstudied features of the anatomy of *C. pansus* does not support revival of *Aphantophryne* either as a monotypic genus or to include the new species. The latter is described as *Cophixalus sphagnicola*, new species.

### INTRODUCTION

In 1969 Zweifel collected four individuals of a small, ground-dwelling and apparently unnamed microhylid atop Mount Kaindi, Morobe Province, Papua New Guinea. The habitus of these frogs was sufficiently like that of montane *Sphenophryne* that he set them aside for later consideration in the course of a proposed revision of that genus. Later, Allison conducted an extensive ecological study of this species. He submitted specimens to Mr. James Menzies, who determined that the species has the skeletal characteristics of the genus *Cophixalus* rather than of *Sphenophryne*. The present paper has two purposes: to facilitate the comple-

tion of Allison's ecological studies by providing a name for the undescribed species; and to investigate whether there is sufficient justification for reviving the genus *Aphantophryne* Fry "1916" [1917] to accommodate both its type species (presently assigned to *Cophixalus*) and the new frog described herein.

### METHODS

Standard measurements were made and utilized in generating ratios used to compare proportions: body length, from snout to vent (SV); length of tibia, from heel to outer side of flexed knee (TL); distance from anterior

<sup>1</sup> Curator, Department of Herpetology, American Museum of Natural History.

<sup>2</sup> Assistant Director, Wau Ecology Institute, Wau, Papua New Guinea.

edge (corner) of eye opening to center of external naris (EN); internarial distance, between centers of external nares (IN); head width, at jaw articulation (HW); diameter of orbit, measured between anterior and posterior edges of eye opening (Eye). Measurements, expressed in millimeters, were made with vernier calipers or ocular micrometer. Statistics are given in the format: mean  $\pm$  standard error of mean (range).

#### ACKNOWLEDGMENTS

This research utilized specimens deposited in the American Museum of Natural History, New York (AMNH), the Bernice P. Bishop Museum, Honolulu (BPBM), and the Australian Museum, Sydney (AM). We are grateful to Dr. Alan A. Ziegler (BPBM) and Dr. Harold Cogger (AM) for their cooperation. Zweifel's participation in the R/V Alpha Helix Expedition in 1969, supported by the National Science Foundation, contributed importantly to the study. Part of the research was carried out while Zweifel was a Visiting Curator in the Australian Museum.

#### STATUS OF *Aphantophryne*

Fry ("1916" [1917]) described the genus and species *Aphantophryne pansa* on the basis of six specimens taken at an elevation of 3719 m. (12,200 ft.) in the Owen Stanley Mountains of British New Guinea (now Papua New Guinea). The principal feature thought to be diagnostic of the new genus was the lack of a sternal plate. Parker, in his revision of the Microhylidae (1934), recognized *Aphantophryne* as a monotypic genus, relying on Fry's description in the absence of specimens to examine. Loveridge (1948) referred *Aphantophryne* to the synonymy of *Asterophrys* after examining (but not dissecting) one of Fry's paratypes, and without reference to the nature of the pectoral girdle. With relatively fresh material available, Zweifel (1956) determined that the type species does possess a sternal plate and otherwise has the skeletal characteristics of the genus *Cophixalus*<sup>3</sup> as diagnosed by Parker

(1934). Zweifel recognized that this squat, short-legged terrestrial frog with rounded toe tips differed from typical *Cophixalus*, which are scansorial frogs with expanded digital tips, but he preferred not to revive a monotypic genus on these grounds alone, so he referred *pansa* to the genus *Cophixalus* and, hence, *Aphantophryne* to the synonymy of *Cophixalus*, where it has remained. The discovery of a new terrestrial, montane species somewhat resembling *C. pansus* calls for comparison between the two and with other *Cophixalus* to determine if revival of *Aphantophryne* may be warranted.

*Cophixalus* was one of five genera of sphenophryne microhylids recognized by Parker (1934), who diagnosed them on the basis of characteristics of the pectoral girdle. The five formed a graded series distinguished by the reduction and loss of ventral elements of the girdle: *Sphenophryne* (girdle complete); *Oreophryne* (clavicle reduced); *Microbatrachus* (clavicle supposedly lost); *Cophixalus* (clavicle and procoracoid lost); *Aphantophryne* (clavicle, procoracoid and, supposedly, sternal plate lost). Several changes in the generic level taxonomy have taken place since Parker's revision. Zweifel (1956) referred *Aphantophryne* to the synonymy of *Cophixalus*, and later (1971) redefined the Sphenophryninae, transferring the genus *Genyophryne* to it. Tyler (1978) disposed of *Microbatrachus* as probably based on a juvenile *Sphenophryne*. Menzies and Tyler (1977) removed the genera *Copiula* and *Choerophryne* from the synonymy of *Cophixalus*.

#### FEATURES OF *Cophixalus pansus* PERTINENT TO GENERIC STATUS

**GENERAL MORPHOLOGY:** The features of morphology that impart to *C. pansus* an appearance rather different from other *Cophixalus* are ones common to ground-dwelling microhylids of several genera: short hind legs, narrow toe tips, broad head, small eyes. Leg length of *pansus* is the shortest relative to body length of any *Cophixalus*. No other *Cophixalus* has digits with no trace of disc development and no trace of terminal

<sup>3</sup> See Menzies, Tyler, and Zweifel (1980) for the use of this generic name.

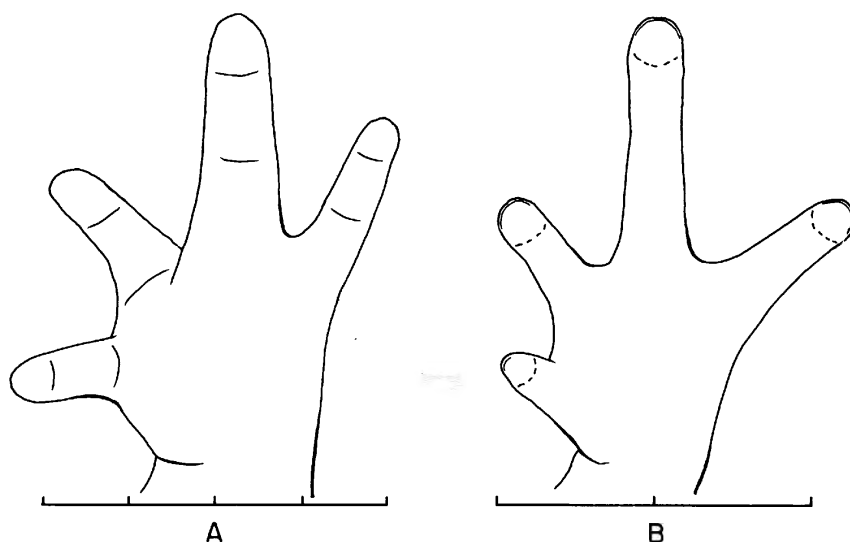


FIG. 1. Left hands of *Cophixalus pansus* (A) and *C. sphagnicola* (B) in palmar aspect. Scale lines marked in mm.

grooves (fig. 1A). The terminal phalanges bear what we assume to be vestiges of the T-shaped extensions of scansorial species (fig. 2D). Relative head width and relative eye size are very nearly at the extremes for the genus in *pansus*.

**VOMERINE BONES:** The shape of the vomers may be diagnostic of microhylid genera (Zweifel, 1972; Menzies and Tyler, 1977), but that of *pansus* does not differ significantly from that of more typical *Cophixalus* (fig. 3D).

**SACRAL VERTEBRA:** The sacral vertebra of *pansus* has the diapophyses relatively little expanded. In this respect it differs slightly if at all from scansorial species of *Cophixalus* (fig. 4).

**PECTORAL GIRDLE:** The sternal plate of *pansus* is weakly developed compared with other *Cophixalus*. Specimens of other species cleared and stained with Alizarin Red often show calcified tissue in the basal part of the sternum, but no calcification is present in a specimen of *pansus*. In other respects the girdle is like other *Cophixalus*. Fry's ("1916" [1917]) impression of the distinctness of the pectoral musculature of *pansus* was accurate within the limited context

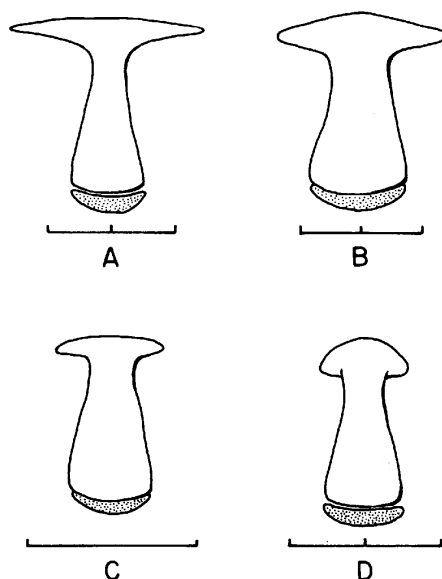


FIG. 2. Terminal phalanges of third fingers to show relative development of T-shaped processes. A. *Cophixalus verrucosus*, a scansorial species. B. *Copiula* sp., a genus of ground-dwelling species, formerly referred to *Cophixalus*. C. *Cophixalus sphagnicola*. D. *C. pansus*. Scale lines marked in 0.25 mm. increments.

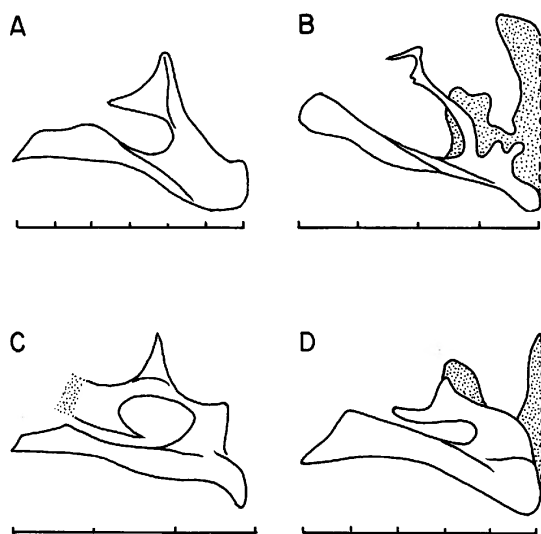


FIG. 3. Vomers of right side in ventral aspect. A. *Cophixalus parkeri*, a scansorial species. B. *Copiula* sp. C. *Cophixalus sphagnicola*. D. *C. pansus*. Stippled areas represent cartilage associated with vomers and sphenethmoids. Scale lines marked in 0.5 mm. increments.

of material available to him, but he had no other *Cophixalus* for comparison.

**THROAT MUSCULATURE:** Variation in throat musculature is assuming significance in assessing relationships among frogs (Tyler, 1971, 1972, 1979; Emerson, 1976). The superficial mandibular musculature of *C. pansus* (fig. 5) is basically similar to that of other microhylids (Tyler, 1979, fig. 4:8; Emerson, 1976, fig. 5): well-developed interhyoideus, intermandibularis (with a single supplementary slip) and submentalis (intermandibularis anterior) muscles.

In *pansus* there is a fairly sturdy muscle (imand d., in fig. 5) lying dorsal to the intermandibularis, between the main body of the intermandibularis and the lateral geniohyoideus. It originates on the mandible and inserts along with the intermandibularis in the region of the median raphe; part of the muscle is visible without reflecting the intermandibularis or its accessory slip. Investigation of other *Cophixalus* and the related genus *Copiula* shows that this muscle is not unique to *pansus*, though better developed in *pan-*

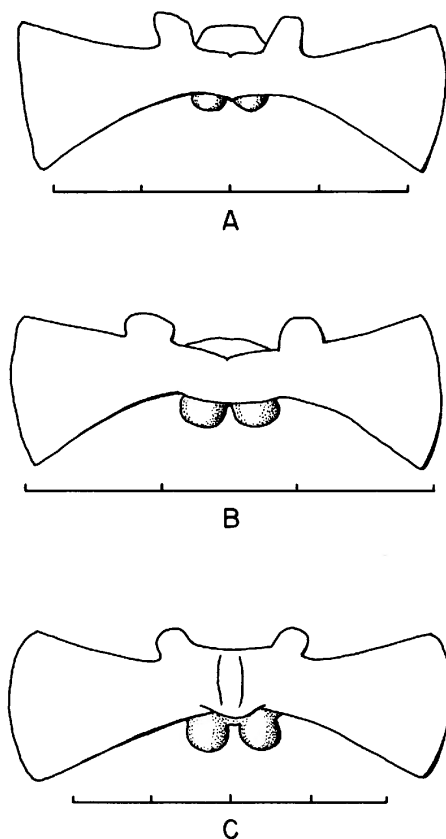


FIG. 4. Sacral vertebrae in dorsal aspect. A. *Cophixalus riparius*, a scansorial species. B. *C. sphagnicola*. C. *C. pansus*. Scale lines marked in mm.

*sus* than in several other *Cophixalus* dissected. In these latter species the muscle may be represented only by fibers distally along the mandible, hidden by the intermandibularis. If the intermandibularis is loosened medially and reflected, the muscle in question reflects with it and may not be recognized.

What presumably is the homologous muscle is well developed in *Copiula*, reaching essentially to the median raphe, but is completely hidden by the intermandibularis.

Emerson (1976, fig. 4) illustrates and notes an "unusual condition" of the intermandibularis in *Kalophrynus pleurostigma*, a microhylid thought not to be closely related to any Papuan species. Here, the intermandibularis

(intermandibularis posterior of Emerson) is divided into smaller anterior and larger posterior parts, with a space between. Such a condition could be a precursor to the division seen in *Cophixalus* and *Copiula*. In any event, the close anatomical relationship of the intermandibularis (in the strict sense) and the muscle in question suggests that pending more comprehensive and detailed study the latter be referred to as a dorsal element of the intermandibularis.

#### FEATURES OF THE NEW SPECIES PERTINENT TO GENERIC STATUS

**GENERAL MORPHOLOGY:** Because of its relatively short hind legs and lack of expanded digital discs, this species more closely resembles *pansus* than it does the more typical scansorial species of *Cophixalus*. Head width, however, is close to average for the genus, and the eyes are relatively large. Terminal processes of the phalanges are only slightly broader than those of *pansus* (fig. 2C), and although the tips of the digits are not expanded, their shape is disclike, and weak terminal grooves are present (fig. 1B).

**VOMERINE BONES:** The shape of the vomer is much like that of *pansus* and typical *Cophixalus* (fig. 3).

**SACRAL VERTEBRA:** The expansion of the diapophyses is similar to that of *pansus* and of scansorial *Cophixalus*—neither greatly expanded nor narrowed (fig. 4).

**PECTORAL GIRDLE:** In a double-stained specimen, the sternal region shows no calcification and little sign of cartilage. Hence, there is a resemblance to the condition in *pansus*.

**THROAT MUSCULATURE:** We cannot identify a dorsal element of the intermandibularis in the new species, but since it can be difficult to see even in larger species of *Cophixalus*, the apparent absence in this small form should not be attributed significance.

#### DISCUSSION

From the foregoing, it is evident that *Cophixalus pansus* differs from more typical scansorial *Cophixalus* chiefly in ways associated with a ground-dwelling as opposed to

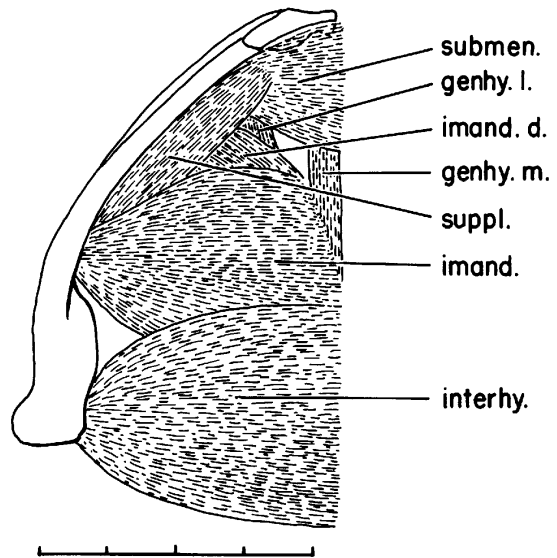


FIG. 5. Superficial throat musculature of *Cophixalus pansus*, right side only. Abbreviations: genhy l., *geniohyoideus lateralis*; genhy m., *geniohyoideus medialis*; imand., *intermandibularis*; imand. d., dorsal element of *intermandibularis*; submen., *submentalis*; suppl., supplementary slip of *intermandibularis*. Scale line marked in mm.

an arboreal or at least climbing way of life: complete absence of toe discs and terminal grooves; relatively small eyes; short legs. The relatively broad head is also seen in many terrestrial Papuan microhylids, though it is not so clearly an adaptation to terrestrial life.

*Aphantophryne* can be diagnosed on the basis of the unique derived conditions of rounded digital tips without discs or terminal grooves; the head, eye, and limb proportions are supporting but less distinctive characteristics. The distinction is blurred, however, when the new species is considered. Its digital tips are not at all expanded, but are somewhat flattened and disclike, and bear weak terminal grooves. The condition is intermediate between typical expanded discs of scansorial species and the state in *pansus*.

An earlier decision that *Aphantophryne* did not warrant recognition as a monotypic genus (Zweifel, 1956) considered the foot structure, pectoral girdle and general habitus

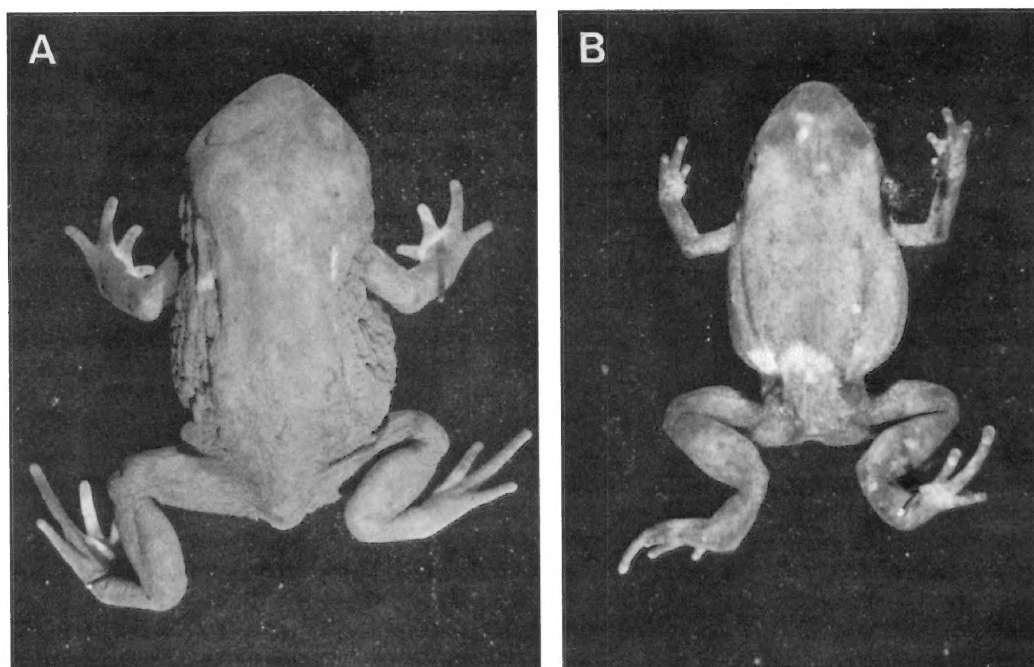


FIG. 6. *Cophixalus* in dorsal aspect. A. *C. pansus*, AMNH 58123,  $\times 2.2$ . B. *C. sphagnicola* holotype, AMNH 83077,  $\times 2.9$ .

of *pansus*. The examination of additional internal characteristics in the present investigation reveals nothing there unique to the species, and the discovery of a new species that is in some ways intermediate between *pansus* and more typical *Cophixalus* further diminishes its distinctiveness. *Cophixalus pansus* represents the extreme of adaptation to terrestrial existence seen in the *Cophixalus* evolutionary line, but to segregate it in a monotypic genus would serve little purpose. To group it with the new species in a genus apart from *Cophixalus* would be inadvisable. Not only would such a genus be much less effectively diagnosed than would the monotypic genus, but such an association would imply a closeness of relationship that present information cannot support. The presumed derived characters that link the two species—leg length and toe structure—are ones notorious for parallel development in Papuan microhylids. Similar morphology is seen in several montane, ground-dwelling species of other genera.

*Cophixalus sphagnicola*, new species

Figure 6B

HOLOTYPE: AMNH 83077 (field no. RZ 9162), adult female, collected by R. G. Zweifel at about 2300 m., near the summit of Mount Kaindi, 5 km. west of Wau, Morobe Province, Papua New Guinea, on September 7, 1969.

PARATYPES: AMNH 83076, 83078, 83079, AMR 31242, same locality as holotype; BPBM 5636, 6354, 6357, 6362, Bulldog Road, 2400 m., 8 km. SSW Wau; BPBM 6347, 6348, Bulldog Road, 2775–2800 m., 13 km. SSE Wau; BPBM 6293, 6294, 6296–6299, Mt. Kumbak, 2800 m., Bulldog Road, 15 km. SSW Wau; BPBM 8311, Bulldog Road, 2500–2700 m.; BPBM 6250, 6251, 6262, Mt. Amungwiwa, 3000 m., 20 km. SW Wau; BPBM 8308–8310, Mt. Missim, 2400 m., 10 km. NE Wau. All localities are in Morobe Province, Papua New Guinea.

DEFINITION AND DIAGNOSIS: *Cophixalus sphagnicola* is a small species, males reach-

ing about 18.5 mm. and females about 20.6 mm. in length from snout to vent. The hind legs are short, first finger less than one-half the length of the second, and tips of digits unexpanded but disclike and with terminal grooves. The only other species of *Cophixalus* that lacks expanded terminal discs on both fingers and toes is *C. pansus*. Larger size (females to 28 mm., males to 22 mm. SV), longer first finger and absence of terminal grooves on digits distinguish *C. pansus* from *C. sphagnicola*.

**DESCRIPTION OF HOLOTYPE:** Body slightly wider than moderately broad head (HW/SV, 0.398); snout shorter than eye, viewed from above appears bluntly pointed, nearly truncate; loreal region flat and almost vertical; nares broadly spaced (IN/SV, 0.104; EN/IN, 0.647); eyes relatively large (Eye/SV, 0.141), interorbital space about 1.4 times width of upper eyelid; tympanum indistinct, located about one-half its diameter behind posterior corner of eye. Fingers unwebbed, relative lengths  $3 > 4 > 2 > 1$ , first finger less than one-half length of second; tips of fingers 2–4 disclike with terminal grooves, but not broader than penultimate phalanges; first finger bluntly pointed with only a faint terminal groove; no distinct subdigital or palmar tubercles—only low, rounded elevations. Toes unwebbed, relative lengths  $4 > 3 > 5 > 2 > 1$ , first toe less than one-half length of second, tips of toes disclike but not broader than penultimate phalanges; a low, rounded inner metatarsal tubercle, other subdigital and plantar elevations scarcely evident. Hind legs relatively short (TL/SV, 0.380). Head, body and front limbs smooth dorsally and ventrally; a few small warts present on sides of body posteriorly and on upper surfaces of hind limbs. Teeth lacking. A median palatal tubercle followed by a low denticulate ridge.

Eyelids, snout, and interorbital area dark brown; side of head—snout to tympanum—dark brown; body and limbs lighter brown dorsally with indistinct small, darker markings; a dark brown triangular patch below cloaca. All ventral surfaces, including limbs, with small pale spots enclosed in a brown reticulum.

**MEASUREMENTS:** SV, 16.3; TL, 6.2; HW, —

6.5; Eye, 2.3; EN, 1.1; IN, 1.7; eyelid, 1.4; interorbital span, 2.0.

**VARIATION IN THE TYPE SERIES:** Females range up to 20.6 mm. snout to vent length and are gravid at as small as 16.3 mm. The largest male measures 18.5 mm., and one of 15.8 mm. has vocal slits so presumably is mature. Selected proportions vary as follows (N = 17): TL/SV,  $0.384 \pm 0.005$  (0.35–0.42); HW/SV,  $0.376 \pm 0.005$  (0.35–0.42); IN/SV,  $0.106 \pm 0.001$  (0.097–0.113); EN/IN,  $0.630 \pm 0.009$  (0.55–0.71); EN/SV,  $0.066 \pm 0.001$  (0.059–0.073); Eye/SV,  $0.131 \pm 0.002$  (0.119–0.148).

Color patterns are variable, although the dark face mask effect is present to a degree in all specimens. Most have an elongate dark postorbital-supratympanic mark that is scarcely seen in the holotype. The upper surface of the snout may be dark, as in the holotype, or may be pale, sharply set off along a transverse midorbital line. A more or less well-developed dorsolateral dark streak often is present, and the middorsal area thus defined may be distinctly paler than the lateral area below the marking. One specimen has a narrow light midvertebral line irregularly edged with darker pigment, and another has a dark X-shaped mark in the scapular region. Ventral surfaces range from dark brown with tiny light flecks to pale with a broken network of melanophores. The average condition of pale spots enclosed within a weak darker reticulum is seen in the holotype. In life, the dorsal ground color is grayish brown to reddish brown, and the ventral surfaces are gray with lighter gray flecks.

The skeleton was examined in one cleared and stained specimen, a female 15 mm. snout-vent length. The coracoids are the only ossified ventral elements of the pectoral girdle. There are no procoracoids or clavicles, and the sternum is scarcely discernible. Some skeletal elements are illustrated in figures 2, 3, and 4.

**CALL:** The call is a train of high-pitched peeps. Individual notes uttered by two frogs (fig. 7) averaged 0.32 and 0.26 sec. in length, with little variation. Midpoint frequencies of the longer calls ranged between 3250 and

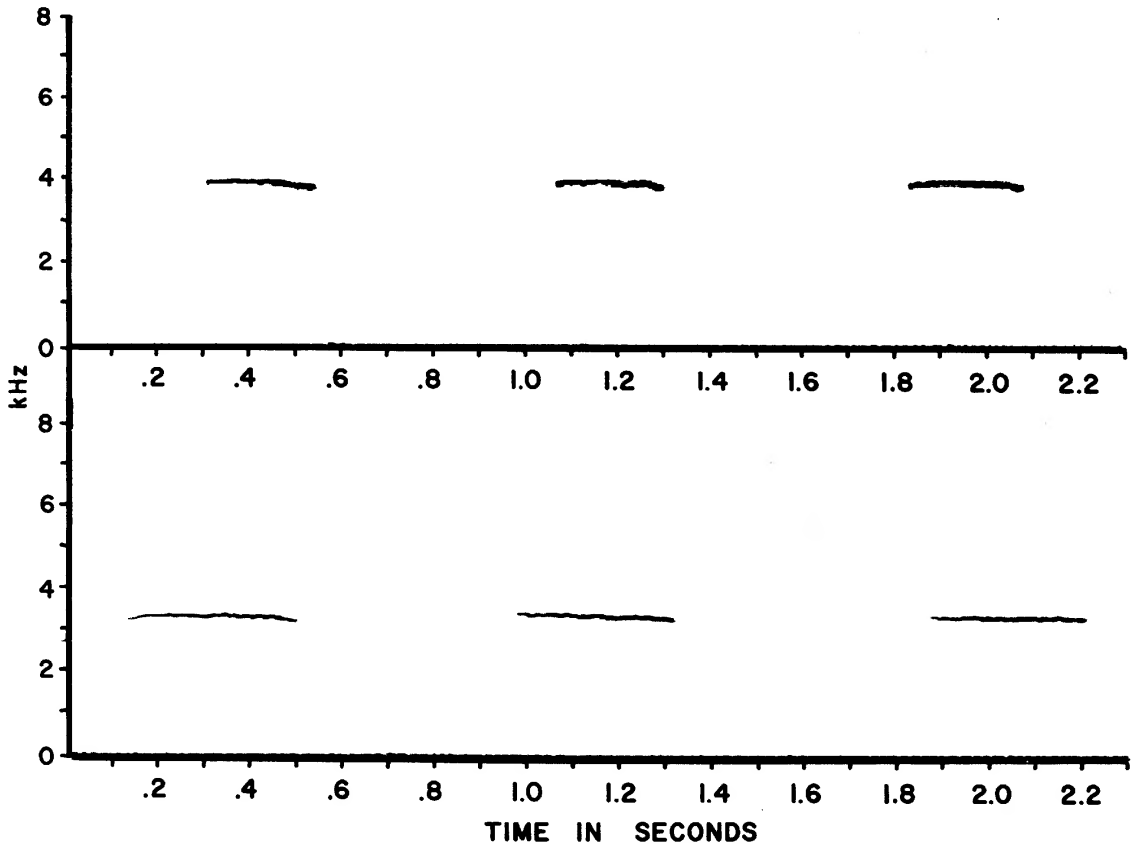


FIG. 7. Audiospectrograms of calls of *Cophixalus sphagnicola*, 45 Hz. filter. Recorded September 12, 1980, by A. Allison on Bulldog Road, Morobe Province, Papua New Guinea. Lower figure shows part of call of A. Allison no. 7194, calling 8 cm. within a mossy bank at a temperature of 12.3°C. Upper figure shows part of call of a second individual (not captured) calling nearby and recorded at the same time as the first frog. Differences seen in frequency, note repetition rate and note length could result from either or both of temperature and body size differences, though a substantial temperature difference under these circumstances is unlikely.

3450 Hz., whereas those of the shorter calls were between 3750 and 3950 Hz. The number of notes in a train varied from 15 to 27 in a sample of 150 calls counted on the summit of Mt. Kaindi and on Bulldog Road (2850 m.), approximately 10 km. from Mt. Kaindi. During peak activity, individuals may call every 30 to 60 sec.

Calling activity on Mt. Kaindi begins shortly before dawn, peaks at first light and then drops off, typically ceasing by midday (fig. 8). Some calling generally resumes in the

afternoon, especially if there is rain. On very rainy days calling may continue at a low level throughout the day. This species rarely calls at night. On Bulldog Road and adjacent areas of the Ekuti Dividing Range the pattern is similar except that calling activity, after peaking at first light, generally continues throughout the day except during infrequent sunny periods. Substratum temperatures while the frogs are calling range from 11 to 15°C.

ECOLOGICAL NOTES: The holotype and



three AMNH paratypes were found beneath chunks of wood and sticks lying beside a trail through heavily mossed forest on Mt. Kaindi, where this species commonly occurs in surface litter beneath clumps of *Gleichenia* ferns or *Rubus* vines along the road to the microwave repeater station. See Gressitt and Nadkarni (1978) for a general description of the area and its vegetation. *Cophixalus sphagnicola* reaches its greatest abundance—more than five individuals per square meter—in second-growth habitat at the edge of heavily mossed forest. On Bulldog Road, built and abandoned during World War II and now heavily overgrown, it occurs most frequently in clumps of *Sphagnum* and other mosses along road banks or under mats of *Vaccinium amblyandrum* covering the former road surface. At high elevations on the Ekuti Divide (e.g., Mt. Amungwiwa) it occurs in alpine grassland, inhabiting *Deschampsia-Danthonia* grass tussocks. It is nowhere common in the forest interior and is virtually absent from deeply shaded mossy forest.

In the lower part of its elevational range (2300–2600 m.) *C. sphagnicola* is sympatric with *Barygenys flavigularis* Zweifel, a slightly larger diurnal terrestrial microhylid (Zweifel, 1972) that inhabits the interior of the forest but also occurs in small numbers at the forest edge. At least five species of *Cophixalus*, all nocturnally active, occur sympatrically with *sphagnicola* on the summit of Mt. Kaindi: *C. cryptotympanum* Zweifel, *C. kaindiensis* Zweifel, *C. parkeri* Loveridge, *C. riparius* Zweifel and *C. variegatus* (van Kampen). The last four are scansorial species; three of them commonly call from shrubs or low trees, whereas *riparius* may be found on vertical road banks as well as high in the taller trees. *Cophixalus cryptotympanum* may call from bushes, but is most often found on the ground beside seeps or along roadside ditches. Its main activity is nocturnal though it may call during late afternoon.

At the Bulldog Road study site, about 2850 m., *C. sphagnicola* is sympatric with *C. pansus*, *C. riparius*, *C. variegatus* and possibly *C. parkeri* (known from a maximum of

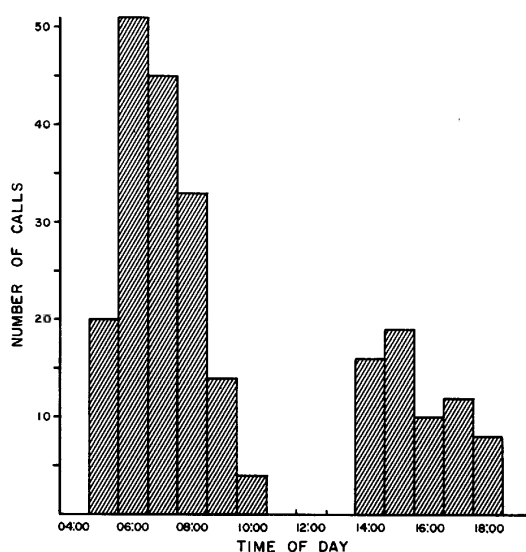


FIG. 8. Number of calls of *Cophixalus sphagnicola* tabulated during 15 minute periods along a 10 m. section of road on the summit of Mt. Kaindi, 2362 m., Morobe Province, Papua New Guinea on February 9, 1981. About 15 male frogs were resident in the study area.

2700 m.). *Cophixalus sphagnicola* and *C. pansus* are similar ecologically. They occur in much the same habitat and, judged by their calling activity, both are active mainly in the morning and less so during the rest of the day. They are the only diurnal terrestrial frogs on the study site. The only other terrestrial species at this elevation is *Sphenophryne rhododactyla* (Boulenger), a large microhylid that roams the forest floor at night.

*Cophixalus sphagnicola* breeds throughout the year on Bulldog Road. Up to 20 eggs per clutch are laid in a shallow depression beneath the surface litter and are attended by the male until they hatch in about three months. Males occasionally call while with the eggs. As is presumably the case with all New Guinea microhylids, development is direct; there is no aquatic tadpole stage.

COMPARISONS WITH OTHER SPECIES: Because of its lack of expanded digital discs, *Cophixalus sphagnicola* is more likely to be confused with species of other genera than

with other *Cophixalus*. With animals of such small size, one must clear and stain representative specimens to be sure of the pertinent skeletal characteristics. The absence of clavicles and of procoracoids coupled with the eleutherognathine condition of the upper jaw (premaxillae not meeting on the midline), will distinguish *sphagnicola* from small individuals of *Sphenophryne* and *Phrynomantis* with similar toe structure. *Barygenys* has vertical ridges on the snout.

Although the new species has been compared with *C. pansus* in determining generic status, it does not necessarily follow that the two species are each other's closest relatives. As has been indicated, their common and presumably derived characteristics may represent parallel adaptations to terrestrial existence.

*Cophixalus sphagnicola* shares some characteristics with a sibling pair of scansorial species, *C. shellyi* Zweifel and *C. pipilans* Zweifel (Zweifel, 1980). These two are small frogs, maximum length about 20–22 mm. snout to vent, with the first finger greatly reduced and with a dark face mask. Fingers, except the first, bear terminal discs, but these are relatively small and are smaller than those on the toes; the reverse is true in typical scansorial *Cophixalus*. The internarial span in *shellyi* is relatively the greatest in the genus, with *sphagnicola* and *pipilans* being closest to it. The call in all three species is a series of high-pitched peeps.

Reduction of the first finger must be considered a derived character, and small size, reduced terminal digital expansions, and broad internarial span may also be derived. No case can be made for regarding the pigmentation or call either primitive or derived. There is no way of determining whether the shared derived characters of the three species reflect common ancestry, but pending additional evidence, it is reasonable to consider *C. sphagnicola* to be a montane terrestrial derivative of the *shellyi*-*pipilans* line of *Cophixalus*.

**ETYMOLOGY:** The specific epithet derives from the Latinized Greek *sphagnus*, moss, combined with the Latin suffix *-cola* (common gender), inhabiting, to form an adjective

descriptive of the frog's habitat on the mossy forest floor.

**DISTRIBUTION:** *Cophixalus sphagnicola* is known only from mountains near Wau, Morobe Province, Papua New Guinea, at elevations from about 2300 to 3000 m. (7500–9800 ft.). Evidently the species is distributed among disjunct populations (fig. 10). Localities and specimens examined are listed under Paratypes, above.

### *Cophixalus pansus* (Fry)

Figure 6A

*Aphantophryne pansa* Fry, "1916" (1917), p. 772 (type locality, "Mount Scratchley, on the Owen Stanley Range, British New Guinea . . . 12,200 ft. [3719 m.]"<sup>4</sup>; holotype, AM R5238, collected by A. Giulianetti in September or October 1896).<sup>5</sup>

*Asterophrys pansa pansa*: Loveridge, 1948, p. 417.

*Cophixalus pansus*: Zweifel, 1956, p. 41.

**DIAGNOSIS:** *Cophixalus pansus* differs from all microhylids of the New Guinea region in the following combination of characters: upper jaw eleutherognathine, clavicles and procoracoids lacking, tips of fingers and toes rounded without terminal grooves and with no trace of discs.

In general appearance, *C. pansus* resembles a ground-dwelling species of *Phrynomantis* or *Sphenophryne* more than it does its scansorial congeners. The eleutherognathine upper jaw (vs. symphygnathine) distinguishes *pansus* from any *Phrynomantis*, and the presence of clavicles differentiates *Sphenophryne*.

**DESCRIPTION AND VARIATION:** *Cophixalus pansus* is a rather squat, relatively broad-headed frog with short hind legs (the shortest relative to body length in its genus) and small eyes. Females reach a maximum length from snout to vent of about 28 mm., males 22 mm.

<sup>4</sup> Mt. Scratchley lies on the border between the Central and Northern provinces of Papua New Guinea; it is uncertain in which province the holotype was collected.

<sup>5</sup> Fry chose and illustrated a holotype from among the six specimens available to him but did not specify a catalog number. However, AM R5238 is segregated and bears a label reading "type."

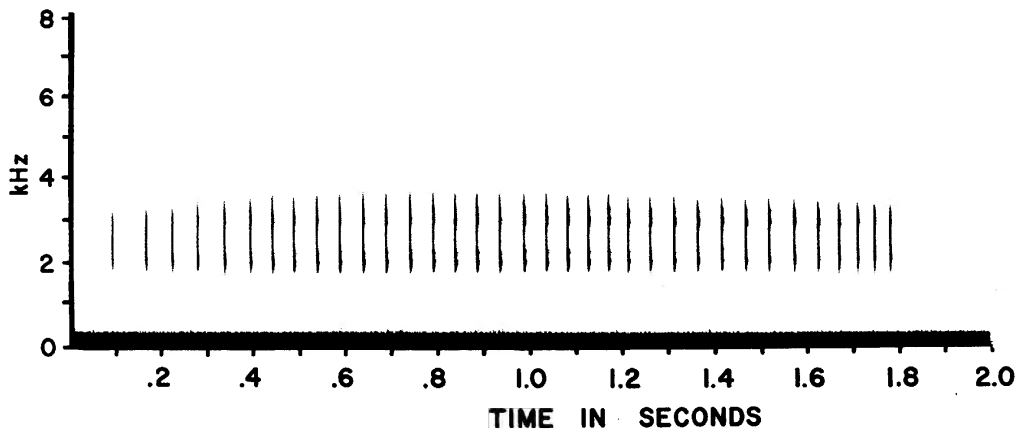


FIG. 9. Audiospectrogram of call of *Cophixalus pansus*, 300 Hz. filter. Allen Allison no. 7195, recorded September 12, 1980 on Bulldog Road, Morobe Province, Papua New Guinea, calling at a temperature of 12.3°C. from 5 cm. below the surface of mossy substratum.

The snout is rounded, verging on bluntly pointed in slightly desiccated specimens, canthus rounded, loreal region sloping and shallowly concave to virtually flat, nostrils relatively close together. The tympanum is indistinct and small, less than one-half the diameter of the eye. Most individuals show a prominent postorbital-supratympanic fold of skin. The dorsal body surface ranges from smooth to rather warty, possibly in part a reflection of the modes of killing and preservation. Relative lengths of fingers are  $3 > 4 > 2 > 1$ , with the first finger well developed, one-half or more the length of the adpressed second finger. Toes are  $4 > 3 > 5 > 2 > 1$ , the first being less than one-half the length of the second. Tips of fingers (fig. 1) and toes are bluntly pointed with no trace of terminal grooves. There are no sub-articular or palmar tubercles, and only very low, rounded inner and outer metatarsal elevations. Some features of the skeleton and musculature have been discussed and illustrated above.

A typical *Cophixalus pansus* in preservative is dark purplish brown above with a narrow pale vertebral line and a pale curved postorbital streak, and is largely pale yellow beneath except for dark areas on the chest, at the base of each arm and at the posterior

end of the abdomen. There is, however, much variation in both dorsal and ventral color patterns. Occasional individuals are dark above and below except for the undersides of the fingers and toes. The vertebral stripe may be lacking, or the dorsum may be pale, or marked with darker pigment in varying degrees. The ventral surfaces likewise exhibit a range from completely unmarked to uniformly dark, though heavily marked frogs are a small minority.

Variation in the several proportions calculated shows no significant sexual dimorphism, and there are no significant differences between northern (Morobe Province) and southern (Central and Northern provinces) samples. Statistics for the pooled samples ( $N = 38$ ) are: TL/SV,  $0.313 \pm 0.002$  (0.29–0.34); HW/SV,  $0.397 \pm 0.002$  (0.36–0.43); IN/SV,  $0.083 \pm 0.001$  (0.072–0.094); EN/IN,  $0.919 \pm 0.010$  (0.68–1.00); EN/SV,  $0.067 \pm 0.001$  (0.060–0.075); Eye/SV,  $0.106 \pm 0.001$  (0.095–0.116).

CALL: The call is a train of clicks with energy widely distributed between about 1700 and 3700 Hz. but with peaks indicated around 2000 and 3000 Hz. (fig. 9). Eight calls of one individual recorded at 12.3°C. averaged  $1.64 \pm 0.04$  sec. in length (range 1.44–1.72). Mean clicks per call were  $34.6 \pm 0.8$

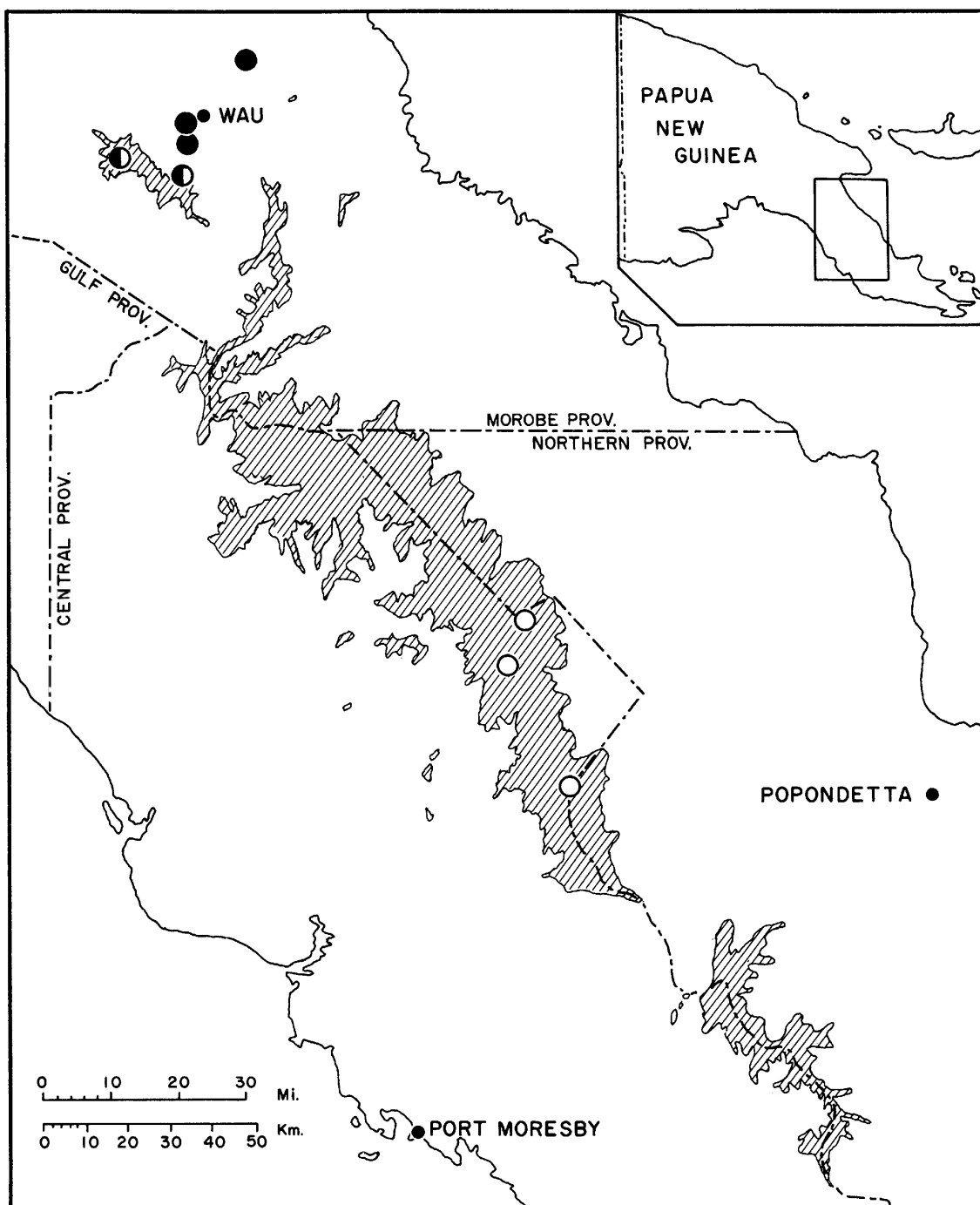


FIG. 10. Distribution of *Cophixalus sphagnicola* (solid and half-filled circles) and *C. pansus* (open and half-filled circles) in Papua New Guinea. Area above 2400 m. is shaded.

(32–39) and mean clicks per sec.  $20.7 \pm 0.7$  (18.1–24.7). Ten calls of a second individual recorded at 12.9°C. have the following statistics: length,  $2.17 \pm 0.05$  (1.87–2.32); clicks per call,  $52.9 \pm 0.8$  (47–57); clicks per sec.,  $24.1 \pm 0.4$  (22.9–27.3). The interval between calls averaged 1 min. 25 sec. (0:47–2:13, N = 7) in the first individual and 1 min. 33 sec. (0:44–2:50, N = 11). These calls were recorded from the northern disjunct population along Bulldog Road. Recordings of calls from the southern population sound the same, but were not analyzed in detail.

ECOLOGICAL NOTES: *Cophixalus pansus* is ecologically similar to *C. sphagnicola* (see above). On Bulldog Road it tends to be slightly more common than *sphagnicola* and at higher elevations in the Wau area (e.g., grass tussocks on Mt. Amungwiwa—ca. 3200 m.) it is the dominant species.

Breeding occurs throughout the year and females may produce up to 30 but generally only 10 to 12 eggs per clutch. The eggs are attended by the male and development is direct.

*Cophixalus pansus* attains a much larger adult size than does *C. sphagnicola*. The ecological consequences of this difference are under study by Allison. Preliminary information suggests that the two species differ significantly in the kinds and size range of prey.

DISTRIBUTION: *Cophixalus pansus* is found at high elevations in the Owen Stanley Mountains and, in an evidently disjunct population, in mountains south of Wau (fig. 10). Apparently it is absent from similar elevations in the mountains of the Kuper Range (e.g., Mt. Missim, 3200 m.) which form the north side of the Wau Valley. Elevations of localities with adequate data range from about 2800 to 3800 m. A distance of about 130 km. separates the northernmost of the Owen Stanley localities from the closest of the northern collection sites, but the intervening area has been little studied, and *pansus* may occur in much of it.

SPECIMENS EXAMINED: *Morobe Province*: Mt. Amungwiwa, about 3000 m., about 20 km. southwest of Wau (BPBM 6246–6248,

6253–6259, 5513); Mt. Kumbak, Bulldog Road, about 13–15 km. south-southwest of Wau, about 2775–2800 m. (BPBM 6276, 6281–6292, 6345, 6346, 6473, 6476, 6477, 6479–6481); Bulldog Road, 2700 m., 35 km. south of Wau (BPBM 8312, 8313). *Northern Province* or *Central Province*: Mt. Scratchley, 12,200 ft. (3619 m.) (AM R5238, holotype). *Northern Province*: Mt. Albert Edward, southwest slope, 3680–3811 m. (AMNH 58103–58105, 58120–58137). *Central Province*: Wharton Range, 2100–2850 m. (BPBM 5300, 5301); Murray Pass, Wharton Range, 2800–3000 m. (AMNH 53397–53401, 58106–58119, 58138–58141, 81133–81138; BPBM 5292–5299; AM R20839, R20948–20951, R21000, R21211–21215, R23464–23508, R24304).

#### LITERATURE CITED

- Emerson, Sharon B.  
1976. A preliminary report on the superficial throat musculature of the Microhylidae and its possible role in tongue action. *Copeia*, no. 3, pp. 546–551, figs. 1–5.
- Fry, Dene B.  
1916 [1917]. Description of *Aphantophryne*, a new batrachian genus from New Guinea; with comparative notes on the pectoral musculature. *Proc. Linn. Soc. New South Wales*, vol. 41, part 4, pp. 770–785, pls. 54–55.
- Gressitt, J. L., and Nalini Nadkarni  
1978. Guide to Mt Kaindi: background to montane New Guinea ecology. *Wau Ecology Inst. Handbook no. 5*, pp. vi + 135, pls. 1–4, figs. 1–48, tables 1–12.
- Loveridge, Arthur  
1948. New Guinean reptiles and amphibians in the Museum of Comparative Zoölogy and the United States National Museum. *Bull. Mus. Comp. Zool.*, vol. 101, no. 2, pp. 305–430.
- Menzies, J. I., and Michael J. Tyler  
1977. The systematics and adaptations of some Papuan microhylid frogs which live underground. *Jour. Zool. (London)*, vol. 183, pp. 431–464, figs. 1–14, pls. 1–3, tables 1–2.

- Menzies, J. I., Michael J. Tyler, and Richard G. Zweifel
1980. *Cophixalus* Boettger, 1892 (Amphibia, Salientia): Proposed designation of type species under the plenary powers. Z. N. (S.) 2298. Bull. Zool. Nomen. vol. 36, no. 4, pp. 231–235.
- Parker, H. W.
1934. A monograph of the frogs of the family Microhylidae. London, British Museum (Natural History), viii + 208 pp., figs. 1–67, 2 maps.
- Tyler, Michael J.
1971. The phylogenetic significance of vocal sac structure in hyliid frogs. Univ. Kansas Publ. Mus. Nat. Hist., vol. 19, no. 4, pp. 319–360, figs. 1–10, tables 1–3.
1972. Superficial mandibular musculature, vocal sacs and the phylogeny of Australo-Papuan leptodactylid frogs. Rec. S. Aust. Mus., vol. 16, no. 9, pp. 1–20, figs. 1–5.
1978. The systematic status of the Aru Islands microhylid frog, genus *Microbatrachus* Roux. Jour. Nat. Hist., vol. 12, pp. 457–460.
1979. Herpetofaunal relationships of South America with Australia, pp. 73–106, figs. 4:1–4:10. In William E. Duellman (ed.), The South American herpetofauna: its origin, evolution, and dispersal. Mono. no. 7, Mus. Nat. Hist. Univ. Kansas.
- Zweifel, Richard G.
1956. Results of the Archbold Expeditions. No. 72. Microhylid frogs from New Guinea, with descriptions of new species. Amer. Mus. Novitates, no. 1766, pp. 1–49, figs. 1–9, tables 1–4.
1971. Results of the Archbold Expeditions. No. 96. Relationships and distribution of *Genyophryne thomsoni*, a microhylid frog of New Guinea. *Ibid.*, no. 2469, pp. 1–13, figs. 1–6.
1972. Results of the Archbold Expeditions. No. 97. A revision of the frogs of the subfamily Asterophryinae, family Microhylidae. Bull. Amer. Mus. Nat. Hist., vol. 148, art. 3, pp. 411–456, figs. 1–79, tables 1–9.
1980. Results of the Archbold Expeditions. No. 103. Frogs and lizards from the Huon Peninsula, Papua New Guinea. *Ibid.*, vol. 165, art. 5, pp. 387–434, figs. 1–14, 1 table.